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**ISIJ International, January 2016**

**Removing tin from tin-bearing iron concentrates with sulfidation roasting using high sulfur coal.** Y. Yu, L. Li, X. Sang

With the sulfidation roasting process using high sulfur coal, the tin could be removed efficiently from tin-bearing iron concentrates, and the iron phase was reduced to metal iron. The research showed that the tin removal rate increased with roasting temperature and residence time. Different with the phenomena using pyrite as curing agent, deep reduction of tin-bearing concentrates did not cause tin remove rate decrease. The reason may be that curing rate of tin phases by the SO2 generated from high sulfur coal pyrolysis was higher, and the formation amounts of iron-tin alloy were decreased. The iron phase was mainly reduced into Fe from Fe2O3 and Fe3O4 in the roasting process. Tin content of the concentrates was decreased to 0.056% under the conditions of N2 flow rate of 60 ml/min, roasting temperature of 1 473 K, residence time of 60 min, high sulfur coal addition amounts of 70% and particle size of 200 meshes. The roasting product can meet the standard of BF ironmaking, which requires tin content in iron ores less than 0.08%. The work supplies a new approach for the clean use of high sulfur coal.

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**Materials Research Innovations S10, December 2015**

**Effect of regeneration atmosphere on the properties of an iron oxide desulphurisation sorbent for high-temperature coal gas desulphurisation.** Y. Xu, J. Shangguan, Y. Gao, H. Fan, J. Mi

Desulphurisation sorbent properties, including desulphurisation activity and mechanical strength, are important in the sulphidation/regeneration cycle for high-temperature coal gas desulphurisation. In this paper, α-Fe2O3 desulphurisation sorbent was prepared and the changes in its mechanical strength and the surface morphology after regeneration in O2, SO2 and SO2–O2 atmospheres were measured with a particle strength tester and by scanning electron microscopy. The mechanical strength of the sorbent was generally higher after regeneration, although the formation and
decomposition of sulphate during regeneration decreased the mechanical strength of the sorbent. The sulphate formation and decomposition depended on the O₂ and SO₂ concentration and the regeneration temperature. The mechanical strength was also increased by the sorbent sintering.

**ENVIROMINE, December 2015**
Assessment of Hydra-Energetic Resources in Small Scale Underground Mining. John Niño and Juan Salamanca

Usually the mining industry generates environmental strong impact on areas in which mining projects are operating. One of the major impacts is on the water resources; for example, when the mine drainage is pouring in the surface water. Currently, a challenge of modern mining industry is to develop processes that do not pollute the environment, especially the water. Mining companies make large investments for treating drainages, which has high cost due to the electricity consumption for evacuating out the drainage. This investment increases according to the mine size and quantity of drainage. Therefore, mine drainage has being seen as an environmental and economic problem for the mining companies. This paper presents an assessment method of hydro-energetic potential in an underground mine, in order to evaluate the possibility of using mining drainage to generate electricity.

**METEC & 2nd ESTAD, June 2015**
Effects of carbonaceous material’s ash on iron carburization at initial reaction stage. K. Ohno, S. Tsurumaru, T. Maeda, K. Kunitomo, D. Senk, H. Gudenau

In this study, several kinds of carbonaceous material samples were prepared. They were crashed and sieved to 45-75 μm, and soaked into acid solutions for predefined time to control ash contents of them. It was found that the acid treatment decreased not only amount of the ash in the carbon samples but also Na concentration of the ash. The decreasing of Na concentration caused increasing of initial ash’s liquid formation temperature and increasing of molten ash’s surface tension. These changes of molten ash’s physical property could decrease molten ash’s wettability against iron and carbon. The carbonaceous material samples were put on a pure iron plate, and they were applied for “insitu” observation of initial Fe-C liquid formation behavior due to iron carburization reaction under a constant heating rate condition with inert gas atmosphere. As a result, it was found that decreasing of ash content in carbonaceous material decreased initial Fe-C liquid formation temperature because ash’s obstruction on reaction area of iron carburization reaction was decreased. In other words, initial Fe-C liquid formation temperature was decreased with increasing of the acid treatment duration because of decreasing of formation amount of molten ash as barrier at reaction interface.

**Models of coke formation for interpretation of dilatometer and sole heated oven tests.** D. Jenkins, M. Mahoney

We have developed mathematical models, based on the fundamental phenomena associated with coke formation, in order to simulate the dilatometer and sole heated oven tests for coking coals. We combine models of gas evolution, multiple bubble growth in softened coal particles, bubble coalescence and gas transport through the sample, to represent the whole test profiles. In particular, our models consider gas transport by diffusion within softened particles, either into growing bubbles or out of the particle surface. Gas transport through the void space between the particles is also accounted for. Overall, the models allow a determination of the variation of the height of the sample with time/temperature, which can be compared with measured data. In addition, they provide information about the internal state of the sample during the transformation. The presence of a vertical temperature gradient in the SHO test provides additional challenge in modelling, as well as insight into the coke formation
process. We will describe aspects of the model development, as well as comparison with measured data.

**Examination of coke formation through microstructure of sole-heated oven tests.** M. Mahoney, R Roest, H Lomas, R. Fetscher, D. Jenkins, R. Pearce, S. Mayo
We have performed micro-CT imaging, using the Imaging and Medical Beamline of the Australian Synchrotron, of samples from sole heated oven (SHO) experiments. To create the samples, a SHO was modified for rapid quenching and removal of a vertical core. The SHO was loaded with a 50mm bed of crushed coal, having a size distribution similar to that of coke oven feed. The bed was heated from below at 20oC/min up to 300oC then 10oC/min until the base of the sample reached 600oC or 625oC, then rapidly quenched, in order to preserve the internal structure of the sample. The 3D images of the samples provide remarkable insight into the coke formation process. They show regions consisting of individual, untransformed coal; single bubbles growing within (presumably) softened coal particles, expanded volumes consisting of large numbers of coalesced voids and resolidified semi coke, some including vertical fissures. Using 3D image analysis we delineate the different regions of carbonization: untransformed coal, initial softening, maximum expansion and resolidification. We also explore properties of the void structures within the sample, such as pore connectivity and pore size distribution. The approach provides a promising means for improving our understanding of the formation of coke microstructure.

**Fos/Mer coke plant ovens repair.** (powerpoint presentation)
Battery 1 and Battery 2 are the highest oldest ovens in the world. In 2008, due to the crisis, the renovation program of the coke ovens was stopped. Despite CTO report of 2009, no corrective actions were taken. Since end 2008…. Each oven has been pushed more than 1800 times…… 15% of their life time.

**Development of a vertical chamber coking oven for upgrading lignites or subbituminous coal.** M. Scheller, J. Kuehn-Gajdzik
In times of rising prices for prime hard coking coals the search for alternatives is being pursued. Coking of lignite or sub-bituminous coal becomes a realistic future scenario. In comparison to hard coal these resources are easily minable but hard to convert into coke. Due to several reasons the current world wide used standard horizontal chamber coking ovens are not suitable for such an application. Lignite and sub-bituminous coals have no baking properties. Therefore these coals have to be pretreated before coking. The only way to produce lumpy coke with acceptable physical strength out of lignite or sub-bituminous coals is to briquette it in advance. In cooperation with the world-wide leader in lignite research, the Technical University Bergakademie Freiberg, ThyssenKrupp Industrial Solutions AG is attending to this subject. The main focus is on the development of a vertical chamber coke oven for this purpose and for separating raw gas from the coal, which shall be fed to a separate gas treatment and by-product plant. The basic concept is derived from the former plant “Schwarze Pumpe” in the Niederlausitz-area in Germany. The briquettes are pre-heated and dried in a first process step. These highly compacted and well dried briquettes are fed into the coking chamber by gravity. The oven’s high flexibility concept enables TKIS to design a coke end temperature between 500 and 1000°C – for production of char or coke depending on customers’ requests. This outdated type of oven is completely redesigned by TKIS to meet current standards and regulations. Because of its highly flexible design TKIS is pursuing the idea to offer applications ranging from extended transport radius for lignite coal up to high-strength blast furnace coke.

**Determination of optimized coke oven chamber dimension in relation to minimum investment costs.** R. Neuwirth, R. Kim
The objective of the paper consists in the presentation of a complex calculation model for the determination of optimized coke oven chamber dimensions in relation to minimum investment costs based on specific production demands. At first, all technical preconditions, such as the desired production capacity, construction space available, coal basis, required wall stability, environmental limitations, etc., have to be defined. Subsequently, the potential options for the overall oven design are defined by calculating matching chamber dimensions, numbers of oven and batteries as well as the required sets of oven machines, numbers of coal towers and quenching systems, under consideration of all technical preconditions at the same time. In a further stage the related quantities of equipment are calculated for each design option and evaluated by individual unit prices in order to estimate and compare investment costs. Comparing differing configurations leads to the conclusion, that regarding economic selection of chamber dimension a cost minimum exists at specific chamber dimensions for any required level of coke production. By utilization of that complex design module TKIS is in a position to provide clients with a tailor-made oven design ensuring environmental sustainability and optimum cost-efficiency according to their specific production requirements, construction space available and environmental evaluation criteria, simultaneously. Slight increases of engineering costs are compensated by lower material/erection-costs, generating a reduction of operating cost in long-term, additionally.

Enhancement of coking properties of coal by differential screening. D. Nag, B. Das, V. Saxena
Coke plays a major role in blast-furnace operation. Quality of coke mainly depends upon the coal used in blend. As the reserve of good coking coal is diminishing, at this point of time, it is important to give emphasis on coal-preparation techniques. Keeping this in mind, this article presents a coal-preparation technique named “differential screening” based on a selective crushing principle. Different types of indigenous and imported coals are characterized and screened in different size fractions. These size fractions are again characterized and carbonization tests are designed based on their properties under stamp-charging condition. This research suggests that the use of a specific fraction of coal in the blend in order to achieve the higher coke strength after reaction (CSR)